CONTENTS

Aerodynamic theory for membranes and sails 1
BARRY G. NEWMAN

Review of adaptive-grid techniques for solution of partial differential equations 29
D. F. HAWKEN

Viscous–inviscid interactions in external aerodynamics 51
R. C. LOCK and B. R. WILLIAMS

Vortical flow management techniques 173
D. M. RAO and J. F. CAMPBELL

Modern turboprop engines 225
H. I. H. SARAVANAMUTTOO

Fluid dynamics of unsteady separated flow. Part II. Lifting surfaces 249
L. E. ERICSSON and J. P. REDING

SUBJECT INDEX

aerodynamics
  unsteady separated flow *see* flow separation
  vortical flow *see* vortex management
aerofoils
  NACA 273–284, 314, 344–349
  see also membranes
airfoil stall *see* flow separation

BOEING 142–146

control of vortex flow *see* vortex management

delta wings, vortical charcteristics *see* vortex management
DFVLR 139–142

flow separation, unsteady 251
  aerodynamics of separated flow 252
  airfoil stall 252
    accelerated flow effect 259
    attached flow theory 253–257
    boundary layer convection lag 257–259
    circulation lag 253–257
    compressibility, effect of 279–283, 285
    dynamic stall 267–278, 283, 285
    high frequency oscillations 272–278
    Mach number, effect of 278–298
    moving separation point effect 261–262
    moving wall effect 259–260
    pitch oscillations 267–270
    plunging oscillations 270–272
    prediction analysis 285–298
    quasi-steady aerodynamics 252–253
    reattachment angles of attack 283
    shock induced 284–298
    spilled vortex effect 262–263, 289
    stall–flutter boundaries 283–284
    static stall characteristics 260–261, 263–266
    time lag effects 253–259
    transient aerodynamics 261–263
  slender wing analysis 298–299
    aeroelastic characteristics 334–344
    attached flow 305–306
    compressibility, effects of 311–314
    lateral aerodynamic characteristics 317–328
    leading edge roundness 314–316
    plunging oscillations 310–311
    roll oscillations 326–328
    space shuttle orbiter dynamics 328–334
    stability 317–328
    static aerodynamic loads 300–305
    swept leading edge 299–313
    trailing edge sweep 314
    unsteady aerodynamic loads 305–311
  vehicle dynamics 344
    analytic extrapolation 349–350
    transition effects 345–349
    simulation problems 344–349
flow visualisation
  apex flap vortices 211
  leading edge compartmentation 179, 182, 196
  membrane in water 15
flows resulting from viscous–inviscid interactions *see* viscous–inviscid interactions
fluid dynamics of unsteady separated flow *see* flow separation

interactions, viscous–inviscid *see* viscous–inviscid interactions

lifting surfaces in unsteady separated flow *see* flow separation

membranes, aerodynamic theory of
  bluff 19–21
  boundary conditions 3–5
  centre of lift 6
  double membrane aerofoils 14–18
  experimental data 8–9
  flow visualisation 15
  impervious equations 6–7
  inviscid theory 10
  luffing of sails 11–14
  parawings 21–23
  sails, classification of 2–3
  tension coefficient 4–5
  three-dimensional sails
    low aspect ratio 21–23
    moderate aspect ratio 23–25
  two-dimensional 4–10

NASA 225
  Ames Research Center 142
  Langley Research Center 174, 183–184, 189, 197, 198, 208, 219
  Marshall Space Flight Center 299
NCSU subsonic tunnel 208, 212, 220

ONERA 139

partial differential equations, solution by adaptive-grid methods
  comparison of methods 46–47
  computational coordinates 32
    transformations 38–43
  Gibb's oscillations 31
  integral minimisation, problems involving 34–43
    one-dimensional 35–36
    time-dependent 36
    two-point boundary value 34–35

internodal pseudoforces, problems involving 33, 43–46
equidistributed nodes 44
one- and two-dimensional 43–46
moving finite element method 40–42
node movement, styles 34
stiff equations 33
truncation error 31, 33, 35, 44
propfans *see* turboprop engines
pylon vortex generator 178–183

RAE aerofoil tests 123, 145–155

Saturn–Apollo launch vehicles 299
sails *see* membranes
separated flows *see* flow separation
see also vortex management
space shuttle vehicles 251
cable trays 286–298, 336–344, 350
launch vehicle 334–337, 350
orbiter 328–334
stall, airfoil *see* flow separation

turboprop engines
Allison T56 235–236
compressor configurations 242–243
engine cycles 232–234
equivalent shaft horsepower 230–231
Garrett 331, 238–239
gearbox design 243–245
General Electric CT7 241–242
history of service 227–229
power requirements 229–232
Pratt and Whitney Canada
PT6 236–238
PW100 241
propfans 225–226, 232
propulsive efficiency 226–227
Rolls Royce Dart 234–235
transmission 243–245
ultra high bypass systems
contrafan 246
super fan 246
unducted fan 245–246

USAF Institute of Technology subsonic tunnel 214

vehicle dynamics *see* flow separation
viscous–inviscid interactions
axi-symmetric transonic flows 137–139
coupling methods 97–100
convergence analysis 106–111
direct 100–101, 106–107, 109
fully inverse 101–102, 107, 110
fully-simultaneous 103–105
quasi-simultaneous 105–107
semi-inverse 102–103, 107, 110
stability analysis 109–111
physical effects 52–57
principles of interactive methods
boundary conditions 82–84
displacement models 59–64
effect of pressure variation 69–75
entrainment equation 85–88, 94–95
entrainment shape parameter 88–90
equivalent inviscid flow 59, 64, 82–84, 162–164
integral methods 84–85, 169–171
matching conditions 57–59, 75–82, 167–169
momentum equation 64–69, 161–171
pressure gradients 69–75, 94
real viscous flow 59
turbulent boundary layers 84–90
wake conditions 75–82, 167–169
three-dimensional flows
analysis 90–97
methods 139–157
pressure correction 94
two-dimensional flows
experimental data 123–127
GA(W)-2 aerofoil 117–119
incompressible 111–121
multiple-element aerofoil 119–122
NACA 4412 aerofoil 114–117
transonic 121–137
trough geometry 111–113
vortex management
apex flap and apex fence 207–215
advantages 207–208
effectiveness 214
fence concept 212–215
flap concept 208–212
smoke visualisation 211
articulated leading edge extensions 201–207
effectiveness 206–207
fuselage-hinged 202–207
variable camber 201–202
forebody manipulation 216–222
asymmetry control 216
effectiveness 222
helical strakes 216–218
strake deployment 218–222
leading edge compartmentation 175–183
aerodynamic characteristics 176–177
control devices 178–183
effectiveness 180–183
smoke visualisation 179, 182
lower surface vortex flaps 189–197
effectiveness 197
flap segmentation 195–197
NASA study 189–192
pressure distribution 192–194
smoke visualisation 196
sharp leading edge projection 183–189
effectiveness 188–189
forced-vortex suction 184–185
upper surface vortex flap 197–201
advantages 197
asymmetric control 198–201
effectiveness 201
pressure characteristics 198